REHABILITATION MEDICINE Adding Life to Years

Stroke Rehabilitation: A Model Predicting Return Home

DAVID B. WILSON, MA; DENISE M. HOULE; *and* ROBERT A. KEITH, PhD, *Pomona, California*

We undertook this study to describe the changes in functional status for patients in a rehabilitation program for acute stroke and to identify the variables that best predict discharge home. Of 282 patients, 75% were discharged home. Increases in functional status were found for all 18 activities of the Functional Independence Measure from admission to discharge. Significant predictors of discharge disposition in a logistic regression model were the admission and discharge functional status scores, length of stay, and living arrangement before the stroke. The functional status at discharge was the most important predictor. Knowledge of these predictors can contribute to more appropriate treatment and discharge planning.

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Stroke is the most common life-threatening neurologic disease and the third leading cause of death in the United States, after heart disease and cancer.[1] The American Heart Association has estimated that there are 500,000 new cases of stroke each year and a prevalence of nearly 2 million survivors.[2] The cost of care plus the loss of earnings has been estimated at $7.4 to $11.2 billion a year in the United States.[3] Medical rehabilitation reduces the economic and social burden of caring for stroke survivors with severe physical and mental impairment by reducing disability and enhancing social functioning.[4]

The focus of stroke rehabilitation is to increase patients' independence despite impairment. Accordingly, patient progress and the results of rehabilitation are assessed by functional status measures. The most frequently used outcome measures are self-care skills, followed by physical function, psychiatric cognition, and communication.[5] Other skills such as social functioning, memory and cognition, bowel and bladder incontinence, sexual functioning, and vocational issues may also be addressed by some measures. The assumption underlying the measurement of functional status is that proficiency in the activities measured is related to the amount of assistance required and to whether a person can function at home.[6]

Stroke outcome research has sought to identify characteristics and prognostic indicators that predict survival, discharge disposition, length of hospital stay, functional status, and neurologic status. This literature has been criticized for inconsistent methods and measures, making comparisons of findings across studies difficult.[7-9] Despite these limitations, review of these studies suggests that a previous stroke, coma from the start of the stroke, bowel and bladder incontinence, perceptual-spatial deficits, and neglect or denial syndrome are inversely related to functional status. Less favorable results have also been attributed to delays between onset and admission,[10,11] although more recent studies have not confirmed this relationship.[8] No clear relationship has been established between age, sex, or hemisphere of stroke and functional outcome. Functional score at admission has also been found to be positively correlated with functional end points[7]; the presence of a spouse seems to be positively related to discharge home.[8]

The purpose of the present study was twofold. First, it described changes in functional status for patients in a comprehensive stroke rehabilitation program. Second, indicators that predicted discharge home were identified. The goal was to enhance our understanding of the factors that influence discharge disposition to facilitate service planning for stroke survivors.

Patients and Methods

Data were collected for a 20-bed inpatient stroke unit from April 1989 through December 1990. This unit is part of a 64-bed, free-standing rehabilitation hospital. There were 309 consecutive admissions of stroke patients; 12 nonhemiplegic patients and 15 patients for whom functional status data were incomplete were excluded, resulting in 282 cases available for analysis. Patient information collected included age, sex, marital status, race, onset-admission interval, primary diagnosis, and living arrangement at admission and discharge. Functional status ratings were completed by treatment staff at admission and again just before discharge.

Functional status was measured using the Functional Independence Measure (FIM).[12] The 18 FIM items are grouped into six subscales: self-care (eating, grooming, bathing, dressing upper body, dressing lower body, and toileting); sphincter control (bladder management, bowel management); mobility (transfers between bed, chair, or wheelchair; toilet; tub or shower); locomotion (walking or wheelchair, stairs); communication (comprehension, expression); and social cognition (social interaction, problem-solving, memory). Each item is rated on a 7-point scale: 1, total assistance; 2, maximal assistance; 3, moderate assistance; 4, minimal assistance; 5, supervision; 6, modified independence; and 7, complete independence. The FIM was developed for the Uniform Data System for medical rehabilitation to establish a national data base with a consistent set of measures. The Uniform Data System is investigating the reliability and validity of this instrument.

Treatment was carried out in a self-contained stroke unit.

From the Research and Planning Center, Casa Colina Hospital for Rehabilitative Medicine, and the Claremont Graduate School, Pomona, California.
Reprint requests to Robert A. Keith, PhD, Casa Colina Hospital, 2850 N Carey Ave, Pomona, CA 91767.

TABLE 1.—*Functional Independence Measure Scores at Admission and Discharge (n = 282)**

Variables	Functional Independence Measure			
	Admission		Discharge	
	Mean†	SD	Mean†	SD
Self-care				
Feeding	3.44	1.55	4.98	1.49
Grooming	3.63	1.49	4.97	1.62
Bathing	2.82	1.63	4.01	1.71
Dressing (upper)	3.12	1.48	4.62	1.80
Dressing (lower)	2.89	1.53	4.19	1.84
Toileting	2.76	1.53	4.17	1.86
Sphincter control				
Bladder	2.73	1.74	4.42	1.95
Bowel	2.98	1.92	4.55	1.77
Mobility (transfers)				
Bed, chair, wheelchair	3.09	1.64	4.35	1.64
Toilet	2.85	1.49	4.20	1.77
Tub	2.77	1.49	4.02	1.60
Locomotion				
Walking or wheelchair	2.38	1.43	4.19	1.78
Stairs	1.71	1.42	2.90	2.00
Communication				
Comprehension	3.16	1.82	4.09	2.00
Expression	3.18	1.86	4.00	2.06
Social/cognition				
Social interaction	3.54	1.87	4.29	1.88
Problem solving	2.99	1.78	3.84	1.81
Memory	3.19	1.86	4.02	1.84

*See text for an explanation of scoring.

†All mean differences between admission and discharge are statistically significant at $P < .01$, adjusted for multiple analyses using the Bonferroni method.

The treatment team comprised a physiatrist, a program manager, and therapists from the following disciplines: physical therapy, occupational therapy, speech, recreational therapy, psychology, and social work.

Patient Population

There were 135 men and 147 women with approximately equal numbers with left and right hemiparesis. In all, 68% of the patients were white, 15% were Hispanic, 4% were African-American, 2% were Asian, and the remaining 11% were not classified. The average age was 69 years, with a range from 15 to 90. The majority of the patients (61%) were married, 29% were widowed, 5% were divorced, 4% were single, and 1% were separated. Of these patients, 91% were living with family or relatives or alone before their stroke.

Most of the patients, 94%, were admitted for rehabilitation for the first time, and 6% were readmissions. Accordingly, 89% were admitted from an acute care facility, 6% from skilled nursing facilities, 4% from home, and 1% from other living arrangements. The mean length of time between the stroke and the admission for rehabilitation was 22 days. The mean length of stay was 31 days.

Results

Functional Status Results

The patients showed pronounced improvement in functional status from admission to discharge. The mean levels of functional status at admission and discharge for each of the 18 FIM items are reported in Table 1. An overall mean score of 2.96 across the 18 items at admission indicated that the patients required moderate to maximum assistance for each of these tasks. The lowest mean level of functioning at admission was 1.71, for ability to climb stairs, indicating that most patients were either unable to perform this task or required maximal assistance. The highest mean level of functioning at admission was for grooming and social interaction (3.63 and 3.54, respectively), with only moderate assistance required by the average patient.

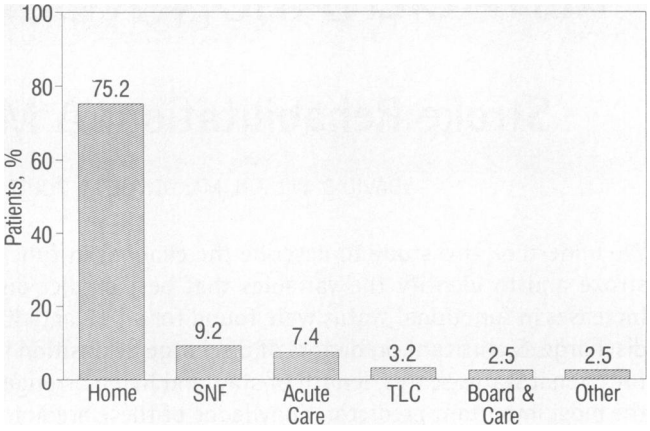

Figure 1.—The graph shows the discharge destination of 282 patients who underwent rehabilitation after a stroke. SNF = skilled nursing facility, TLC = transitional living center

At discharge, all but 2 of the 18 items had a mean score above 4, which reflects a minimal level of assistance required to perform the tasks. Patients continued to require a high level of assistance for climbing stairs and problem solving. The mean scores for these tasks were 2.90 and 3.84, respectively. A multivariate repeated measures analysis of variance indicated a significant difference between a linear composite of the 18 FIM admission and discharge items ($F[18, 264] = 44.00, P < .0001$). Univariate t tests further showed that the discharge mean was significantly higher than the mean admission score for each of the FIM items ($P < .01$).

Who Goes Home?

As shown in Figure 1, the majority of patients in this study, 75%, were sent home. To identify those characteristics that predict return home, a logistic regression analysis was done, with home versus not home as the dichotomous dependent variable.

Variables commonly cited in the stroke literature as predictors of outcome were used in the first logistic regression model. The predictor variables were age, sex, side of hemiplegia, length of stay, onset-admission interval in days, marital status (married = 1, not married = 0), living arrangement before stroke (home = 1, not home = 0), total FIM score at admission, and total FIM score at discharge. Age, sex, marital status, onset-admission interval, and side of hemiplegia did not contribute significantly to the prediction of discharge disposition.

The second logistic regression model tested included only the significant variables from the first analysis: total FIM score at admission, total FIM score at discharge, living arrangement before stroke, and length of stay. The results from this logistic regression model are presented in Table 2. This model correctly classified the discharge disposition of 83% of the patients. The model was a significant improvement over the null model ($\chi^2[4] = 78.1, P < .001$), which would predict that all patients return home and thus correctly classify 75%. The classification table (Table 3) shows that the model successfully predicts 96% of those patients who return home but only 59% of those patients who do not return home. Comorbidity, a factor not included in the

TABLE 2.—*Logistic Regression Analysis Predicting Return Home*

Variable	B	95% Confidence Interval	Odds Ratio
Admission FIM score	0.02*	0.004-0.04	1.02
Discharge FIM score	0.03†	0.01-0.04	1.03
Previous living arrangement	1.71†	0.72-2.70	5.51
Length of stay	0.05†	0.02-0.07	1.05

FIM = Functional Independence Measure

*$P < .05$.
†$P < .001$.

TABLE 3.—*Classification of Predictions From Logistic Regression*

Observed	Predicted: Home	Predicted: Not Home	Correct Prediction, %
Home	197	15	93
Not home	32	38	54
Overall	229	53	83

model, may account for why the model is less successful in predicting those who do not return home. Patients discharged to an institutional setting commonly have more medical complications.

To facilitate interpretation of the logistic regression, the mean scores for admission FIM, discharge FIM, and length of stay by discharge disposition are presented in Figure 2. Patients who returned home had higher functioning as measured by the total FIM score at admission (56.4 versus 43.6) and discharge (82.1 versus 56.9). Patients returning home also remained in rehabilitation longer (32.8 compared with 23.1 days). This may reflect a tendency to keep longer the patients who seem to have more promise for functioning successfully at home. Of the patients discharged home, 95% had lived at home before their stroke, compared with 83% of the patients who did not return home.

Discussion

The efficacy of intensive rehabilitation for stroke after the acute phase of medical care has been shown by a series of randomized controlled studies based on the population of Edinburgh, Scotland.[13,14] Functional independence at discharge was greater for those in the stroke unit, and their length of stay was shorter.[13] Two additional population-based controlled trials compared special stroke rehabilitation units with general medical wards and found a higher percentage of persons living at home at 3 and 12 months after onset.[15,16] These randomized trials indicate that specialized rehabilitation treatment leads to gains that are not explained by spontaneous recovery.[17]

The Framingham study is a longitudinal study in which 148 long-term stroke survivors in a Massachusetts town were observed beginning in 1948.[18] This investigation found that 78% of stroke survivors were independent in ambulation six months or more after their stroke. Furthermore, 68% were independent in activities of daily living, and 85% were living at home. These studies substantiate the potential for recovery from stroke and the contribution that rehabilitation can make in the recovery process.

The current study indicates that substantial gains occurred during rehabilitation. At admission, most patients required moderate to maximal assistance on all 18 activities assessed by the Functional Independence Measure. The average level of assistance required by patients at discharge had decreased to between moderate and minimal assistance for all tasks but climbing stairs and problem solving. These levels allowed patients to live at home with the help of relatives or friends.

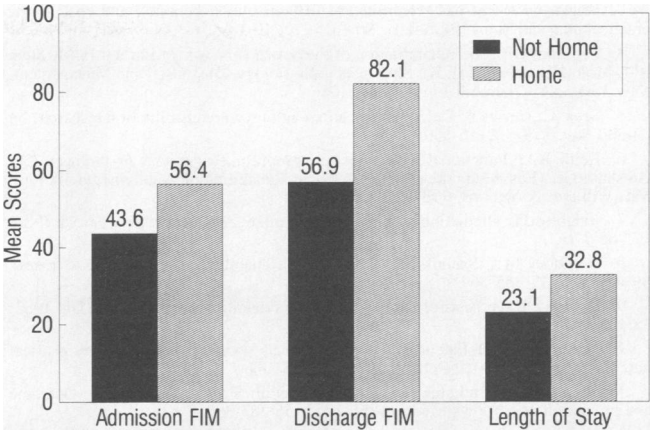

Figure 2.—The functional status and length of hospital stay as they relate to discharge disposition are shown by mean Functional Independence Measure (FIM) scores.

The logistic regression model accurately predicted discharge disposition for 83% of the patients. Factors related to discharge home were higher patient functioning at admission and discharge, longer rehabilitation stays, and living at home before the stroke. Age, sex, marital status, onset-admission interval, and side of hemiplegia did not make independent contributions to the prediction of discharge disposition. Although Kelly-Hayes and co-workers reported that the occurrence of institutionalization increased with age for women,[19] our finding was that age was not related to discharge status. DeJong and Branch showed that marital status was the most important predictor of living arrangement, particularly for men.[20] Likewise, Kelly-Hayes and associates found support for an interaction between sex and marital status on return home, with the presence of a spouse being significant for men but not women.[19] The nonsignificance of marital status in the present study may be attributed to a selection bias toward admitting patients with a spouse or other relatives with whom they may live. The findings with respect to sex, onset-admission interval, and side of hemiplegia are consistent with those reported elsewhere.[19,20]

A comparison of the results with similar logistic regression analyses is limited because success rates for predicting living arrangement were not reported.[19,21] The importance of functional status, however, is consistent with the prediction models tested by other researchers,[19-21] underscoring the value of functional assessment measures in stroke outcome research.

This study suggests that in addition to functional status, living arrangement before a stroke is an important indicator of patients' potential to benefit from rehabilitation. These characteristics can help provide a basis for rational planning for stroke survivors.

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ABOUT AGING—READING *YOUR* LIPS

I'm going to a lip-reading class on Monday afternoons, and I'm the dumbest member of the class.

My chauffeur and mentor, Oliver, takes me in his car, and then wishes he could persuade the members of the class that he doesn't know me. I get silly. It's not right and I've got to stop, but a lot of it just strikes me as funny. It isn't.

There we sit, maybe six men and three women. We face each other, behind tables arranged in a semicircle, and every eye is on the attractive teacher, Mrs Callaway. Now, she's something else; she comes from 14 years at Loma Linda, and the audiologists there give her top rating in teaching lip reading. She's about the age of our oldest granddaughters, maybe. There she goes, waving her hands, walking up and down in front of us, and talking without making a sound. Her body language, which is part of lip-reading techniques, plainly says, "I'm working at this—read my lips!" There we sit, eyes glazed, focusing on her face, furrowed brows with bifocals slipping down our noses, mouths slightly open so we can concentrate better—and everybody but me gets what she's saying.

Oliver again: We share a disability, but he is grimly determined to turn his into an asset. I don't quite know what I want, or didn't, until I learned that this type of class requires a lot of concentration, and if you can manage that, you won't be as likely to deteriorate mentally.

I needed to hear that. It's a cogent argument. Mrs Callaway talks her silent language to each of us in turn, and I watch each student. Sometimes I can get the student's silent response—those are the times Mrs Callaway gives me a gold star. Not often. You see, my problem is not so much with sound as it is with separating words; if you're a fast talker, you might as well be talking Choctaw for all I'd know. You see, deafness is a two-way street; the speaker has to do his or her part, too; I've seen occasions when it was the speaker causing the problem for the deaf listener. And speakers begin to wonder if their uppers are falling down when the deaf person keeps looking at their mouth instead of their eyes. Well, as for that—you'll never learn to lip-read by looking at the speaker's eyes. Relax.

My good friend Mary is deaf but lip-reads like a dream; she sits in church and during the sermon visits with a deaf friend across the aisle.

I must get down to concentrating, mind my manners, and not bother Oliver. No horsing around. Read their lips.

JOSEPHINE SMITH
Claremont, California

Born in 1899, Mrs Smith writes a column, "About Aging," for the *Claremont Courier*, Claremont, California. She retired from teaching creative writing in 1989—except for a few "old" students. Reprinted with permission. She was recently honored by the California Newspaper Publishers Association with a first-place prize for columns published in a newspaper of between 3,500 and 13,000 circulation—one of the most competitive divisions.